Technical Principles for Diagnostic Fluoroscopic Procedures

Shellie Pike, MSRS, RRA, RT(R)(CT) *Cedar Rapids, IA*

Diagnostic fluoroscopy procedures are performed daily in radiology suites across the country. These procedures can be safely performed by avoiding some commonly encountered pitfalls. All personnel involved in the radiologic examination have a role in making sure all patients' procedures are performed in a safe manner.

According to a 2001 article in RadioGraphics, *Fluoroscopy: Patient Radiation Exposure Issues*, "radiation dose delivered during fluoroscopy procedures is highly dependent on the operator" [1]. However, most manufacturers install a variety of tools on fluoroscopy equipment to help personnel adhere to the ALARA (as low as reasonably achievable) principle [2].

One option for ensuring the procedure is performed safely and efficiently is to employ a pre-procedure checklist for commonly performed procedures [3]. Using a checklist has been shown to reduce fluoroscopic times among residents while also improving communication among team members involved in the procedure. The checklist could be modified for each facility but might include some of the items in recent checklist articles [4,5,6].

Diagnostic fluoroscopy is a modality that involves visualizing the anatomy using radiation in real time. Therefore, patient doses have a potential for being great, increasing the chance of adverse reactions. The first pitfall commonly encountered is excessive fluoroscopy times [1]. All persons working in the radiology suite, especially the fluoroscopist, should be cognizant of the fluoroscopy time. While the fluoroscopy time is not an accurate indicator of actual patient dose, it is important to keep overall fluoroscopy time as low as possible while performing an adequate procedure. Low fluoroscopy times lead to lower patient exposure because there is less "beam on" time. FDA regulations require all fluoroscopy units to be equipped with a timer that alerts the user to excess amounts of fluoroscopy (usually after 4.5 or 5 minutes of use).

Another pitfall that is commonly encountered is not using the last image hold/save grab feature [1]. This is often one of the easiest and most effective ways to reduce a patient's radiation exposure. When fluoroscopy is stopped, an image continues to be displayed on the monitor. The last image hold/save grab feature allows the image to be saved, thus reducing the need for another exposure. Generally, this does not compromise procedure quality. The patients' doses are decreased proportionally the more frequently this option is used.

A third pitfall that is often encountered is that the pulse rate [6,7,8] is not appropriately set. By using the lowest pulse rate possible, patient dose and fluoroscopy times are also lowered. Most fluoroscopy procedures do not require continuous fluoroscopy and can be accurately performed using pulsed fluoroscopy as low as 7.5 pulses per second.

One exception to this is the videofluoroscopic swallowing study [9] which requires a pulse rate of at least 30 to adequately visualize the patient's swallowing mechanism. Additionally, by reducing the frame exposure, radiology personnel can also reduce patients' exposure level dramatically. Most procedures can be done on single exposure or at a rate of 1–2 exposures per second while maintaining adequate image acquisition.

Another common pitfall is incorrect distance between the patient and the image intensifier. The image intensifier [1] should be placed as close to the patient as safely possible, thus decreasing both magnification and patient dose. Employing this practice will also result in increased resolution and image quality. Also, whenever possible, collimation should be used to display only the area of interest on the monitor. This procedure limits the amount of tissue being exposed to radiation, thereby decreasing the patients' overall radiation dose.

Removable grids offer a large reduction in radiation dose and are especially useful during pediatric procedures [10]. Not all fluoroscopy units have removable grids available. However, if the unit does have a grid that can be removed, it should be removed to reduce patient dose. Making it a common practice of removing the grid when it is not necessary can result in radiation dose reductions well over 50 percent without degrading image quality.

Another common pitfall encountered in fluoroscopy suites involves not using the most appropriate techniques**.** Appropriate techniques should be applied according to the procedure type and patient size. This will ensure that the kVp and mAs are appropriate for the procedure being performed. For example,

if a barium enema is being performed, a higher kVp would be employed to adjust for patient's body habitus and the higher density of the contrast being used. However, a shoulder injection does not require such a high kVp because the body part is much smaller and the contrast is not as dense.

Patient safety should remain the primary focus during fluoroscopic procedures but care must also be taken to ensure that all personnel involved in the procedure are as safe as possible. By using appropriate personal protective devices and monitoring [11], the staff involved in the procedure will receive the lowest possible dose.

Lead aprons, lead barriers and thyroid shields should be employed by anyone who stands in the room during the procedure. This will ensure that personnel and bystanders are protected from exposure to scatter radiation from the patient. Additionally, if personnel are expected to have their hands exposed during a procedure, lead gloves can be used. Lastly, for staff members who are routinely exposed during fluoroscopic procedures, consideration should be given to the use of lead glasses and radiation dose monitoring equipment during the procedure.

By remaining cognizant of these guidelines and following them as often as practical, we should be able to reduce the incidence of adverse reactions to the patient due to excess radiation and improper technique.

REFERENCES

1. Parry RA, Glaze SA, Archer BR, The AAPM/RSNA physics tutorial for residents — fluoroscopy: patient radiation exposure index. Radiographics 2001; 21:1033-1045 p. 1040. Available at: http://pubs.rsna.org/doi/full/10.1148/radiographics.19.5.g99se211289. Accessed September 26, 2014.
2. US Nuclear Regulatory Commission glossary. Available at: http://www.nrc.gov/reading-rm/basic-ref/glossary/alara.html. Accessed September 26, 2014.
3. Staff article, Health Imaging. Available at: http://www.healthimaging.com/topics/practice-management/rsna-pre-imaging-checklist-helps-cut-fluoro-times-residents. Accessed September 26, 2014.
4. Image Gently Pause and Pulse Checklist. Available at: http://www.pedrad.org/Portals/6/Procedures/Pause%20and%20Pulse%20Checklist%20MDs.pdf. Accessed October 7, 2014.
5. Image Gently Technologist Check-Off List for Fluoro Examinations. Available at: http://www.pedrad.org/Portals/6/Procedures/TECH.CHECK.pdf. Accessed October 7, 2014.

6. Radiation protection in fluoroscopy: International Atomic Energy Agency. Available at: https://rpop.iaea.org/RPOP/RPoP/Content/Documents/Whitepapers/poster-patient-radiation-protection.pdf. Accessed October 1, 2014.

7. Lederman HM, Khademian ZP, Felice M, Hurh PJ, Dose reduction fluoroscopy in pediatrics. Pediatr Radiol 2002;32(12):844-48. Available at: http://link.springer.com/article/10.1007/s00247-002-0696-5. Accessed September 26, 2014.

8. Hernandez RJ, Goodsitt MM, Reduction of radiation dose in pediatric patients using pulsed fluoroscopy. AJR. 1996;167: 1247-1253. Available at: http://www.ajronline.org/doi/pdf/10.2214/ajr.167.5.8911190. Accessed September 26, 2014.

9. American Speech-Language Hearing Association guideline for speech-language pathologists performing videofluoroscopic swallowing studies. Available at: http://www.asha.org/policy/GL2004-00050/. Accessed October 1, 2014.

10. Hernanz-Schulman M, Goske MJ, Bercha IH, Strauss KJ, Pause and Pulse: Ten Steps that Help Manage Radiation Dose During Pediatric Fluoroscopy. AJR 2011;197(2): 475-481. Available at: http://www.ajronline.org/doi/full/10.2214/AJR.10.6122. Accessed September 26, 2014.

11. Miller DL, Vano E, Bartal G, Balter S, Dison R, Padovani R, Schueler B, Cardella JF, de Baere T., Occupational radiation protection in interventional radiology: a joint guideline of the Cardiovascular and Interventional Radiology Society of Europe and the Society of Interventional Radiology. Cardiovasc Intervent Radiol 2010;33:230–239. Available at: http://link.springer.com/article/10.1007/s00270-009-9756-7. Accessed September 26, 2014.